CAPTURE AND TELEMETRY TECHNIQUES FOR DOUBLE-CRESTED CORMORANTS (*PHALACROCORAX AURITUS*)

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ABSTRACT: Double-crested Cormorants (*Phalacrocorax auritus*) often roost in cypress oxbows and nest on islands making their capture for research studies difficult. In the southeastern United States we used a capture technique involving a boat equipped with flood lights, flushing the birds out of their roost trees, and capturing them with a landing net. On the Great Lakes we devised a capture technique using modified padded leg-hold traps placed in nest trees or on the ground in the colony. We captured >250 cormorants using these two techniques with very few injuries to the birds. In a study with captive birds, we evaluated the short-term effects of backpack and patagial tag VHF transmitters and their attachment techniques for use on cormorants. We conclude that backpack VHF transmitters are applicable for use on Double-crested Cormorants and that patagial solar powered transmitters should be further tested. We also tested two methods for simultaneously attaching a VHF transmitter and a backpack satellite transmitter to cormorants. Birds with the VHF patagial tag attachment showed moderate to heavy feather wear and abrasions on the ventral surface of the patagium. We recommend gluing the VHF transmitter to the backpack satellite transmitter for attaching both VHF and satellite transmitters to Double-crested Cormorants. These adaptable cormorant capture and telemetry techniques should prove suitable for use in other habitats and situations.

KEY WORDS: attachment techniques, capture, Double-crested Cormorant, *Phalacrocorax auritus*, trapping, VHF, satellite telemetry, telemetry

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INTRODUCTION

During the 1970s and 1980s, populations of Double-crested Cormorants (*Phalacrocorax auritus*) wintering in the lower Mississippi Valley dramatically increased (Alexander 1977-1990). The number of cormorant nesting pairs in the Great Lakes more than doubled from 1991 to 1997 (Tyson et al. in press), and data from the Breeding Bird Survey show a 22% annual mean increase of cormorants in the Mississippi flyway (Sauer et al. 1997). The concomitant expansion of commercial catfish (*Ictalurus punctatus*) production in the southeastern United States has contributed to increases in wintering cormorant populations and thereby brought the birds into conflict with fish farmers (Glahn and Stickley 1995). Wintering Double-crested Cormorants commonly forage at commercial aquaculture facilities (Glahn et al. 1995; King et al. 1995) and are estimated to cost the Mississippi aquaculture industry $2 million annually (Glahn and Brugger 1995). In addition to southeastern aquaculturists, sport and commercial fishermen and fisheries managers are concerned about cormorant impacts on fisheries in the Great Lakes and the southeastern United States (Glahn et al. 1998; Schneider et al. 1998). The various interest groups involved are all seeking ecologically sound strategies for dealing with the effects of burgeoning Double-crested Cormorant populations.

To develop more effective, ecologically acceptable management strategies, biologists frequently must capture cormorants for pen and free ranging telemetry studies. Double-crested Cormorants in the southeastern United States usually roost in bald cypress (*Taxodium distichum*) oxbows and in the Great Lakes nest on islands were they are difficult to capture. Here we describe two techniques to capture Double-crested Cormorants wintering in the southeastern United States and breeding in the Great Lakes. We also describe studies with captive birds to determine the most appropriate transmitter attachment techniques for both VHF and satellite telemetry studies of cormorants.

Previous VHF radio telemetry studies of Double-crested Cormorants in the delta region of Mississippi have used tail mounted transmitters (King et al. 1995; King 1996). The morphological and behavioral effects of these transmitters on cormorants was not known and many transmitters were lost during these studies possibly due to the transmitter's weight and the bird's molting tail feathers. Backpack transmitters, however, have been successfully attached to Shags (*Phalacrocorax aristotelis*) with elastic harnesses or glued directly to the feathers for short term studies (Wanless et al. 1991; Wanless et al. 1993). To our knowledge no studies have been conducted to test the effects of transmitters and their attachment on Double-crested cormorants. Therefore, prior to conducting new telemetry studies, we evaluated the effects of VHF backpack and patagial-tag transmitters and their attachment techniques on Double-crested Cormorants.

Satellite transmitters, also known as Platform Transmitter Terminals (PTTs), have been used to monitor the movements of some large waterbirds (Falk and Moller 1995; Davis et al. 1996; Petrie and Rogers 1997). To our knowledge, however, satellite telemetry has not been used on Double-crested Cormorants. We conducted a second study to determine the most appropriate method for simultaneously attaching VHF transmitters and PTTs prior to conducting Double-crested Cormorant satellite telemetry studies.

METHODS

Capture

King et. al. (1994) described a technique developed for capturing cormorants wintering near aquaculture intensive areas of the southeastern United States. This technique involved using a boat equipped with flood lights, flushing the birds out of their roost trees, and capturing them with a large fish-landing net.

Modified Softcatch® leg-hold traps have been used previously to capture American White Pelicans (*Pelecanus erythrorhynchos*) and Great Blue Herons (*Ardea herodias*) in the southeastern United States (King et al. 1998). To capture cormorants for a telemetry study in western Lake Erie we further modified this technique by placing these traps in the colony nesting trees. On Middle Island, Ontario cormorants typically nest in trees 3 to 8 m above ground level. An 18 m extension ladder was used to set traps at the edge of cormorant nests. Traps were camouflaged with a flour-water mixture to simulate cormorant guano and a layer of lose nesting material or detritus. The shock cord and cable were either passed through the nest or removed to reduce their obvious presence. Traps were monitored constantly and once captured, birds could not fly due to the weight of the trap but were able to flap unharmed to the ground. The birds were restrained and checked for general body condition before a transmitter was attached.

Transmitter Attachment

Test Facility. The transmitter attachment studies were conducted at the USDA National Wildlife Research Center's aviary at Mississippi State University. This facility comprises three 0.04 ha test ponds (approximately 1.5 m deep) separated by fencing and netting. During the studies each pond was stocked with approximately 100,000 catfish fingerlings per ha. Both over-the-water and bank perches were available to the birds for loafing and roosting.

VHF. In December 1996 we captured 12 Double-crested Cormorants from night roosts in the delta region of Mississippi using methods described by King et al. (1994). The birds were transported to the aviary where they were weighed and checked for general body condition and feather wear. Birds were then wing-clipped and marked with uniquely numbered aluminum leg bands. Four birds were randomly assigned to each of two treatment groups and one control group. Birds in the two treatments were outfitted with either backpack (27 g) or patagial solar powered transmitters (22 g). We modified the backpack harness described by Dunstan (1972) by incorporating Teflon ribbon, tying, and gluing the knots. A scalpel and cattle ear tag pliers were used to attach the patagial tags. The total transmitter package weights were <3% of the average body mass of a Double-crested Cormorant (Glahn and Brugger 1995). After transmitter attachment the birds were released in the ponds and allowed to forage freely. This study was conducted from 11 through 19 December 1996 with no acclimation period.

PTT. On two successive nights in March 1998 we captured 15 cormorants in night roosts in the delta region of Mississippi (King et al. 1994). All birds were placed in three 2 m x 3 m cages with perches and 1 m diameter x 30 cm deep plastic pools filled with fresh water daily. Each bird was weighed and banded with a uniquely numbered aluminum band before being placed in the cages. Each bird was provided 500 g of live channel catfish/day (Glahn and Brugger 1995) while in the small cages. Six to seven days after their initial capture all birds were re-captured, re-weighed and checked for general body condition. Five birds were randomly assigned to each of two treatment groups and a control group. Birds ~~in the treatment groups were~~ outfitted with either VHF transmitters (14 g) glued to backpack PTTs (30 g) or VHF patagial-tag transmitters (22 g) and backpack PTTs (30 g). The total package weights for the transmitters were 47 g and 57 g, respectively (<3% of an average cormorant's body mass). The attachment methods were the same as described for VHF transmitters. Birds were then randomly assigned to one of two identical ponds and allowed to freely forage and fly within the test pen. This study was conducted from 10 to 18 March 1998.

All procedures used in these studies were approved by the National Wildlife Research Center's Institutional Animal Care and Use Committee. We assumed that cormorant body weights would rapidly decrease and the birds would not be able to swim or dive normally if transmitter attachment problems arose. At the end of each study all cormorants were checked for signs of overt feather wear, skin abrasions, or lesions and re-weighed. We also used ANOVA to compare weight loss or gain among groups.

RESULTS

Capture Techniques

More than 200 cormorants were captured by boat with only two fatalities. Using modified leg-hold traps, 21 cormorants were captured at the Middle Island, Ontatio colony during the early summer of 1999. All but three captures were by the leg; two were caught by a wing and one had its bill caught in the trap. All birds used in the study were examined immediately after capture and no evident injuries were discovered. After transmitter attachment all birds were successfully released. One bird's leg was broken, however, during a capture attempt that used a trap (without the shock absorbing bungee cord and swivels) anchored to the tree. This bird was released without a transmitter being attached.

Attachment Techniques

VHF. Post-study examination of the birds showed no skin abrasions, overt feather wear or loss for either treatment group. Only one bird (a control bird) lost $\geq$10% of its body weight during this study. Weight loss varied among treatment groups ($F_{2,9}=10.50$, $P=0.004$; two-way ANOVA), with weight loss for birds in the control and backpack groups greater than that for birds in the patagial tag group ($P<0.05$) (Table 1).

PTT. Backpack-only birds had less feather wear and abrasions than birds with a patagial tag-backpack. One backpack-only bird showed slight feather wear on its right patagium from the Teflon ribbon. All patagial-tagged birds had moderate to heavy feather wear on the ventral surface of the patagium around the tag button with 3 mm to 3 cm enlargements of the hole in their patagium. None of the patagial-tagged birds, however, showed any sign of tissue necrosis around the hole in the patagium. Thirteen of 15 birds lost weight while being held in the small cages prior to the start of this study; six lost >10% of their body weight within seven days. Thirteen of 15 birds gained weight during the study, but weight change did not vary among groups ($F_{2,12}=1.08$; $P=0.369$; two-way ANOVA) (Table 2).

Table 1. Mean weight changes (g) of Double-crested Cormorants with control (no transmitter), backpack, patagial tag VHF transmitter harness attachments, December 1996.

	N	$\bar{x}$	SE	Range
Control	4	-250	50	-200 to -400
Backpack	4	-175	25	-100 to -200
Patagial	4	-75	25	0 to -100

Table 2. Mean weight changes (g) of Double-crested Cormorants with control (no transmitter), backpack VHF and PTT, and patagial tag VHF transmitters, March 1998.

	N	$\bar{x}$	SE	Range
Control	5	+154	87	-70 to +400
Backpack	5	+30	66	-210 to +160
Patagial and backpack	5	+154	48	+30 to +300

DISCUSSION

Capture Techniques

Use of a boat equipped with flood lights was a useful and efficient technique for capturing cormorants in winter night roosts in the southeastern United States. No other methods of capturing cormorants in their winter roosts have proven to be as effective. We used boats most successfully in remote lakes and oxbows on very dark still nights, preferably with no moon or artificial lights (e.g., city lights). Modified leg-hold traps were useful and efficient for capturing tree nesting cormorants in the Great Lakes. During capture attempts, however, modified leg-hold traps should not be anchored (e.g., tied to a tree or staked to the ground) without the shock absorbing bungee cord and swivels in place. These traps should also be useful for capturing nesting and loafing cormorants in other types of habitats.

Attachment Techniques

VHF. The reason why birds in the control and backpack groups lost more weight than birds in the patagial tag group is unclear. Birds in two of the three groups losing weight suggests that biologists should incorporate a minimum three day acclimation period for telemetry studies using these capture and attachment techniques. We think, however, that the acclimation period is necessary more for the bird to recover from the stress of capture and handling than from transmitter attachment. The results of this pen study and the data from birds equipped with backpack transmitters in subsequent field studies indicate that the backpack VHF transmitter attachment technique is applicable for use on Double-crested Cormorants. Lacking field data, we feel that further testing should be done on the use of patagial tag VHF transmitters on Double-crested Cormorants.

PTT. We think that the reason the birds held in the small cages prior to the study lost weight was because very few of the birds ate the live fish offered to them. The birds may not have been able to adapt to catching fish in a shallow pool where they could not dive and pursue their prey or they were stressed due to capture and confinement. After the birds were released into the larger ponds and allowed to forage freely all but two gained weight. Therefore, we recommend that cormorants should not be held in small cages containing more than two birds for more than one or two days without large deep water pools (1.5 m diameter x 1 m deep).

Birds with a VHF patagial tag and a PTT backpack appeared to have more trouble adjusting to the packages. Birds in this test were not wing clipped and were allowed to fly within the pens, which may explain the tears in the patagium. We observed several birds fly into the netting separating the ponds and cling to the netting with their bills, wings and feet for a few seconds before they flew to the water or a perch. The patagial tag-PTT birds may have caught their tags in the netting causing slight to moderate tears of the patagium. The combination of extra weight (the VHF patagial tag-backpack PTT package in this study weighed 10 g more than the backpack-only package) and stress from having two separate packages attached to these birds may be responsible for some of these effects. Or more simply, the 22 g patagial tag may have been too heavy for free ranging Double-crested Cormorants. Therefore, we believe that gluing the VHF transmitter to the backpack PTT is the best method of attaching a VHF and PTT to Double-crested Cormorants.

Future satellite telemetry studies of Double-crested Cormorant continental movements will be based on the results of these captive bird experiments. Although further modifications may be necessary, these techniques should be useful for capturing cormorants and conducting telemetry studies in areas other than the southeast and Great Lakes.

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